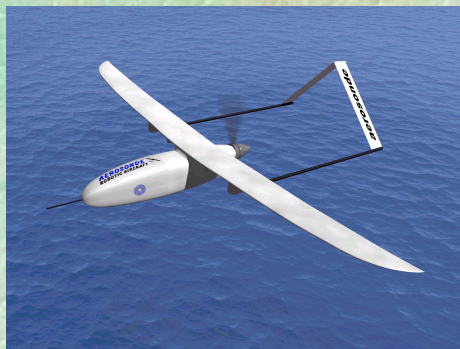
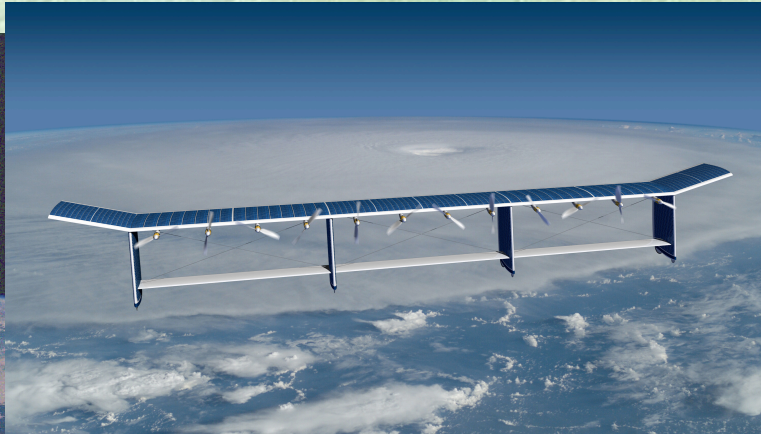
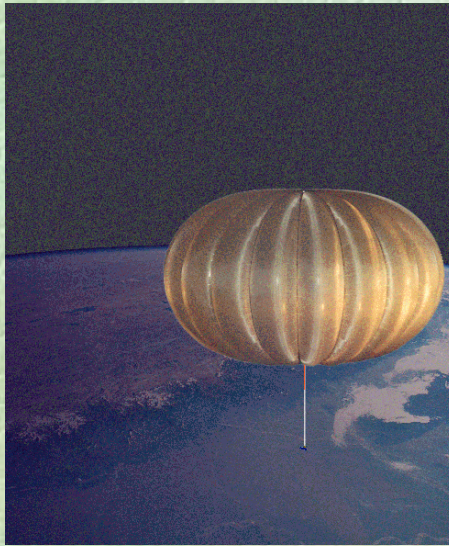


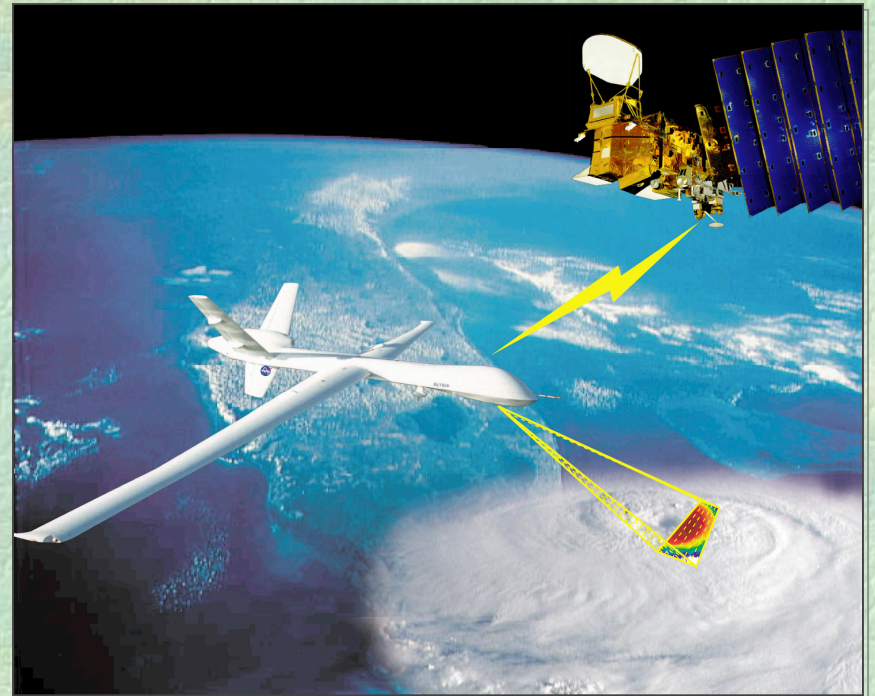
Suborbital Science Missions of the Future



Earth Science Enterprise Suborbital Science

Intro/background

The Mission of the Suborbital Program is to Enable Earth science research and applications by providing an in-atmosphere observational capability to augment space-based systems, and to provide targeted characterizations of regional or localized phenomena at high spatial and temporal resolutions.

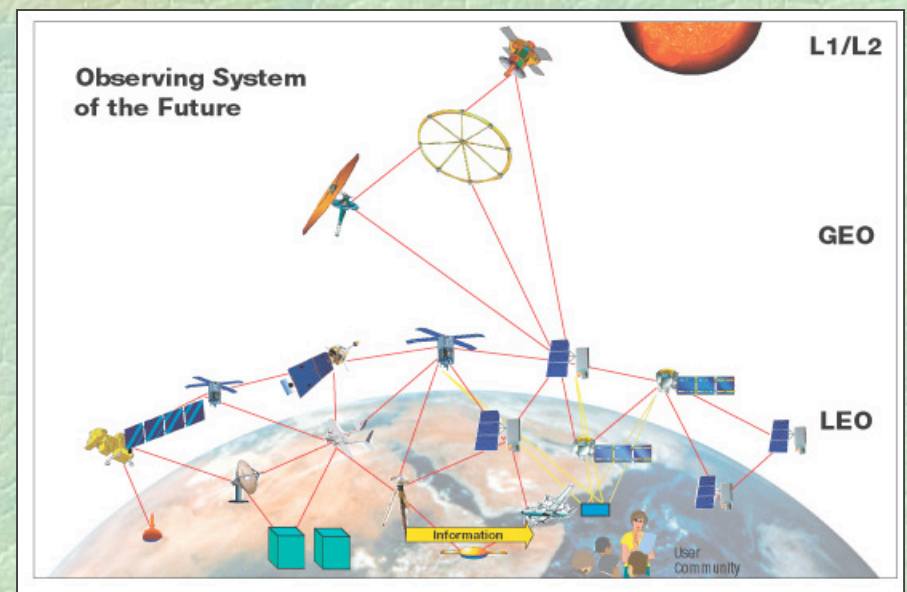


Suborbital Science Missions of the Future

Concept Development

Purpose:

The Suborbital Science Program needs to evolve new, capable and affordable platforms to meet the observational needs of the Earth science community . New evolving unmanned technology promises to extend the altitude and endurance of observational platforms, building the suborbital measurement space of current platforms toward the unique vantage point of space.



UAV Science Demonstrations

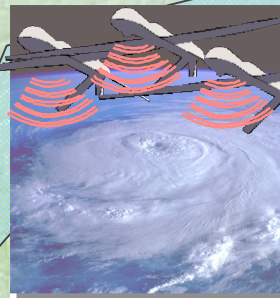
Enhancing Science Capability through Autonomy

Mission Capability

Integrated
Autonomous
Observations

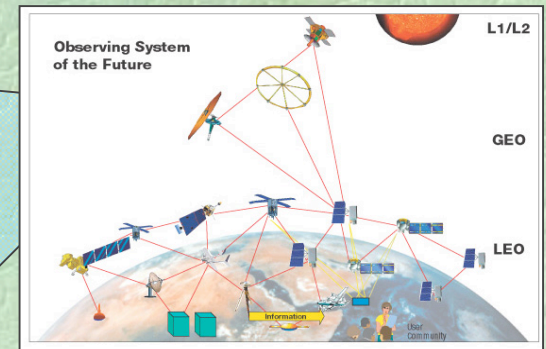
Coordinated
Multi Platform

Independent
Remote Sensing



Adaptive mission
planning

Operations by
special
consideration



Autonomous
adaptive campaign
management

Remotely Guided

Group Coordination

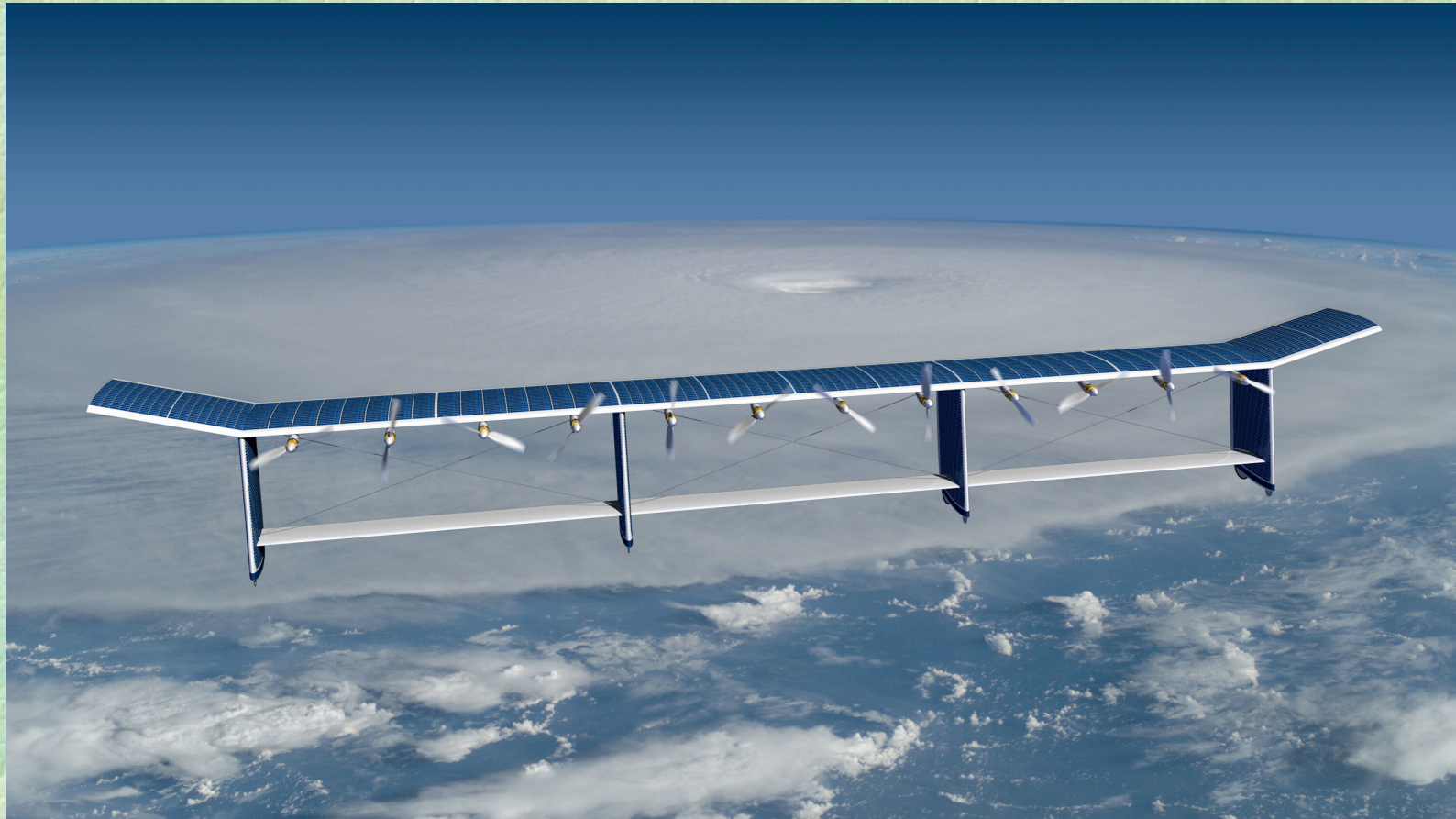
Group Tactical Goals

Group Strategic Goals

Degree of Autonomy

High Altitude Long Endurance Remotely Operated Aircraft

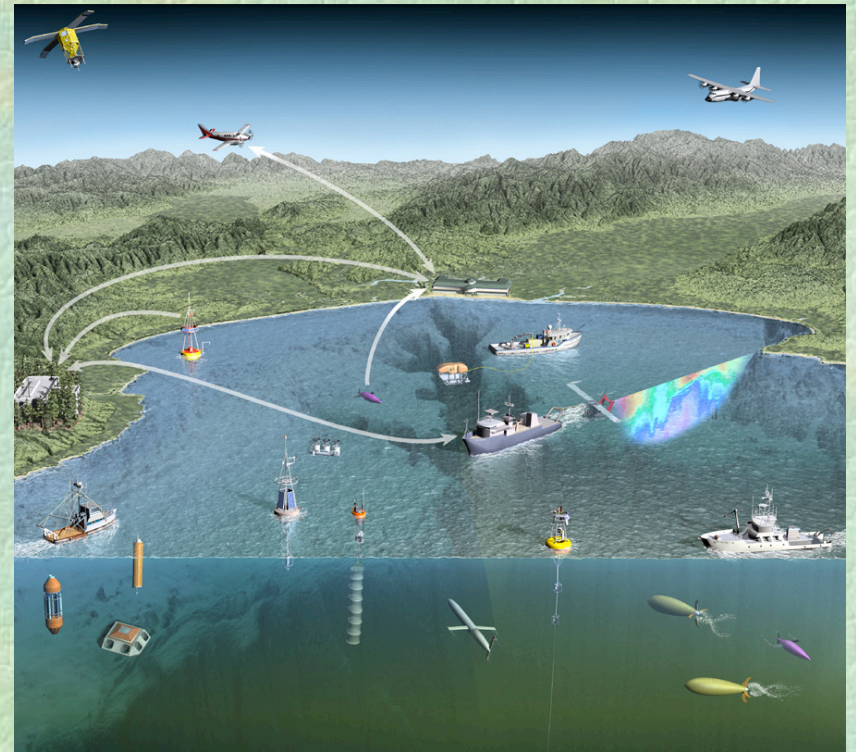
5-year Capability



14-day endurance, 60-70K ft ops, 400 lb payload

Intelligent Mission Management Vision

- Real Time Monitoring with Adaptive and Autonomous Mission Management (Dynamic Re-plan and Mixed-Initiative Behaviors)
- Coordinated Multi Agent Observations
- Collaboration and Visualization tools
- Robust, extensible, reconfigurable payloads

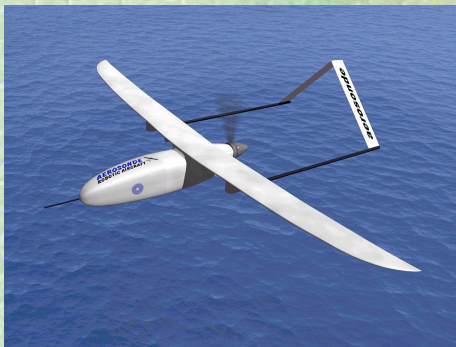


Suborbital Science Missions of the Future

The Suborbital Science Missions of the Future activity (SSMF) has as its objectives to carry out *studies* and a *workshop* that outline future science investigations and which describe the requirements for future integrated airborne systems, such as uninhabited aerial vehicles (UAVs) or other innovative platforms, for collecting Earth observations in support of ESE scientific objectives.

Directed Studies

- ✓ Carbon Cycle
- ✓ Solid Earth
- ✓ Climate Variability



Mission Concepts of the Future Workshop

- ✓ Atmospheric Composition
- ✓ Water & Energy Cycle
- ✓ Weather
- ✓ Carbon Cycle
- ✓ Solid Earth
- ✓ Climate Variability

Workshop Objectives

Observation / Measurement Definition:

- *For each priority science question, what do we want to observe or measure? How would we describe the phenomena we want to measure?*
- *How does this observation or measurement support this ESE science focus area?*
- *What is the advantage of using a suborbital platform for this measurement?*

Observation / Measurement System Requirements:

- *How specifically do we want to observe or measure it?*
- *What are the instrument / payload characteristics (type, weight, volume, environmental considerations, and access such as sampling or viewing ports)?*
- *What are the flight characteristics (location, altitude, endurance, season, frequency)?*
- *What are the communications needs (such as real-time data or instrument control)?*

Mission Concept:

- *What are the key elements of the mission concept? Describe a measurement approach. Provide a narrative describing a “day-in-the-life” of this mission. Provide a diagram showing flight profile in time, space and/or geographic coordinates. Identify any special or unique platform or mission issues.*

Workshop Approach

- ✓ Provide background, context and approach
- ✓ Bring together key researchers in the six science theme areas
- ✓ Highlight progress from on-going Directed Studies
- ✓ Session Leads to provide leadership to drive to developing system requirements to enable research focus area roadmap implementation
- ✓ Share progress with larger workshop
- ✓ Drive to meeting summary (Template)

Facilitators and technical experts will be available to participants to support the development of these mission concepts

Directed Studies

Carbon Cycle - Matt Fladland

Climate Variability - John Sonntag, Rick Hale

Solid Earth - Carol Raymond

Highlight Progress to date including

- ID of science question(s)
- Observational requirements (duration, altitude, # of platforms, etc)
- Data collections and expected products
- Synergies with other projects/programs
- Expected outcomes
- Special considerations, issues and concerns, lessons learned

